REGULATORY ANALYSIS OF ARTIFICIAL INTELLIGENCE AND BLOCKCHAIN WITH SPECIAL REFERENCE TO HEALTHCARE IN SMART CITIES

A

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BY

Ms. Prachi Mishra
(RSILS200056)

Under the Supervision of

Dr. Ashish Kumar Singhal

Associate Professor

ICFAI Law School

The ICFAI University, Dehradun

ICFAI LAW SCHOOL
The ICFAI University,
Dehradun

The ICFAI University, Dehradun

Candidate's Declaration

I, **Prachi Mishra**, declare that the synopsis titled, **"Regulatory analysis of Artificial Intelligence and Blockchain with special reference to Healthcare in Smart Cities"** being submitted in the partial fulfillment of the requirement for the award of the degree of Doctor of Philosophy in Law under ICFAI Law School, The ICFAI University, Dehradun during the academic year 2022-23.

It is the work that is expected to be carried out under the supervision of **Dr. Ashish Kumar Singhal**. It is further declared that the synopsis is within the plagiarism limit and copy of the same is attached as per the University norms.

Prachi

Candidate's Name: Prachi Mishra **Date: 20-02-2023**

The ICFAI University, Dehradun

CERTIFICATE

This is to certify that the thesis entitled, **"Regulatory analysis of Artificial Intelligence and Blockchain with special reference to Healthcare in Smart Cities"** is an original piece of work done by ***Ms. Prachi Mishra*** under my supervision being submitted in the partial fulfillment of the requirement for the award of the degree of Doctor of Philosophy in Law under ICFAI Law School, The ICFAI University, Dehradun during the academic year 2022-23.

Further, it is certified that the synopsis is within the plagiarism limit and copy of the same is attached as per the University norms.

A. K. Singh

Signature of the Supervisor in full

Name: Dr. Ashish Kumar Singhal

Designation: Associate Professor

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ABSTRACT

As the world witnesses rapid urbanization and technological advancements, the integration of Artificial Intelligence (AI) and Blockchain technology in healthcare systems has become increasingly significant. The primary aim of this thesis is to explore and analyze the regulatory frameworks governing AI and Blockchain applications in healthcare, with a particular focus on Smart Cities in India, while comparing the approaches with those of the United States and the European Union.

The study employs a comparative methodology to identify key differences, similarities, and trends among the three regions. A thorough analysis of legislation, guidelines, and policy documents is conducted to provide an in-depth understanding of the regulatory landscape. Additionally, the research highlights the challenges faced by stakeholders in implementing these technologies in healthcare, along with the potential solutions and best practices.

The findings of the study reveal that while the United States and the European Union have made significant progress in establishing comprehensive regulatory frameworks, India still faces considerable challenges in this area. The thesis identifies a need for clear and harmonized regulations in India to ensure that AI and Blockchain technologies are effectively and ethically employed within the healthcare sector. Furthermore, the research demonstrates that international cooperation and dialogue are essential for promoting the responsible and sustainable development of AI and Blockchain technologies in healthcare across the globe.

Overall, this thesis contributes valuable insights to the growing body of research on AI and Blockchain regulation, particularly in the context of healthcare in Smart Cities. The analysis and recommendations presented in this work will serve as a useful reference for policymakers, industry stakeholders, and researchers seeking to develop and implement effective regulatory frameworks in this rapidly evolving domain.

Keywords: Artificial Intelligence, Blockchain, Healthcare, Smart Cities, Regulatory Framework.

Introduction

The ongoing technological revolution has witnessed the rapid emergence and adoption of Artificial Intelligence (AI) and Blockchain technology in various sectors, significantly transforming the way we live, work, and interact. Among these sectors, healthcare stands out as one of the most important and sensitive areas where these cutting-edge technologies have the potential to bring substantial improvements to patient care, data management, and overall efficiency. The integration of AI and Blockchain in healthcare has become particularly relevant in the context of Smart Cities, where the primary goal is to enhance the quality of life and promote sustainable development through intelligent and data-driven solutions.

In healthcare, AI and blockchain have the potential to improve patient care, streamline clinical workflows, and reduce costs. However, they also involve the collection and storage of sensitive personal health information, which raises significant privacy & security concerns[1] and also ethical and social implications, such as the potential for bias, discrimination, or lack of transparency.[2] Furthermore, significant liability and accountability issues, particularly in the case of medical errors or adverse events are also a matter of concern. For example, who is responsible when an AI system misdiagnoses a patient or when a blockchain-based medical record is hacked?

To address these challenges, regulations such as the Health Insurance Portability and Accountability Act (HIPAA) in the US, the General Data Protection Regulation (GDPR) in the EU, and the Personal Information Protection and Electronic Documents Act (PIPEDA) in Canada provide guidelines for the collection, use, and disclosure of personal health information. These regulations require healthcare organizations to implement appropriate technical and organizational measures to protect patient data from unauthorized access, use, or disclosure.

In India, steps have been taken to regulate the use of these technologies in the sector. **The Medical Council of India (MCI)** has issued guidelines for the use of AI in healthcare,[3] which include recommendations for the development of ethical and legal frameworks for the use of AI

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[1] Liu, V., Musen, M. A., Chou, T., Tarczy-Hornoch, P., & Hersh, W. (2020). Sensitive Information in Medical Dialogue Generation: A Multi-stakeholder Analysis. Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency, 281-290. https://doi.org/10.1145/3351095.3375627

[2] Mittelstadt, B. D., Fairweather, B., Shaw, M., McBride, N., & Allo, P. (2019). The ethics of personal health monitoring. Nature Digital Medicine, 2(1), 1-7. https://doi.org/10.1038/s41746-018-0074-x

[3] Medical Council of India. (2020). Telemedicine Practice Guidelines Enabling Registered Medical Practitioners to Provide Healthcare Using Telemedicine. https://www.mohfw.gov.in/pdf/Telemedicine.pdf

in healthcare, the need for transparency in the use of AI, and the importance of ensuring that AI is used in a manner that is consistent with human values and dignity. In addition, the Ministry of Health and Family Welfare has released a draft of the **Digital Information Security in Healthcare Act (DISHA),** which seeks to regulate the use of electronic health records (EHRs) and other digital health technologies, including AI. The draft bill includes provisions for the protection of patient data, the regulation of health data repositories, and the establishment of a national digital health authority.[4]

Analyzing specifically the three smart cities recognized for the research, i.e. Lucknow, Hyderabad and Pune, the regulatory frameworks of these smart cities would provide insights into how different regions in the country are addressing the regulatory challenges posed by AI and blockchain in healthcare. Further, there have been many steps taken by these three smartcities in the field of healthcare and technology.

Lucknow: the capital of Uttar Pradesh, is one of the fastest-growing cities in India and has been selected as a Smart City under the Indian Government's Smart Cities Mission. The city is witnessing significant investments in healthcare infrastructure, technological advancements, and innovative solutions to address the growing healthcare needs of its population.

Hyderabad - Hyderabad is another smart city in India that has made significant strides in adopting smart technologies in healthcare. The city has launched several initiatives such as the **"Urban Health and Climate Resilience Centre"** and the **"Hyderabad e-Health App"** to enhance the delivery of healthcare services.[5] The analyses of the regulatory framework in Hyderabad will help to understand how the Indian government is regulating AI and blockchain in healthcare.

Pune - Pune is a rapidly developing smart city that has implemented several projects related to healthcare and technology. The city has launched initiatives such as the "**Smart Health Card**" and the "**Pune Smart City Health Initiative**" to improve the quality of healthcare services.

Despite all the steps India needs a full-fledged coded regulatory framework that deals with the issues of the disruptive and innovation technologies.[6] In order, to be well equipped with the situation of technological advancement and the issues arising, regulators may need to establish clear guidelines for the deployment, ethical development and use of AI and Blockchain technologies in Healthcare to ensure that they do not perpetuate or amplify existing social and

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[4] The Ministry of Health and Family Welfare. (2018). Draft Digital Information Security in Healthcare Act (DISHA). https://main.mohfw.gov.in/sites/default/files/DISHA%20Draft%20Bill%202018%20%281%29.pdf

[5] Syed A. (2021). IoT in Smart Cities: A Survey of Technologies, Practices and Challenges. 4(2), 429-475. https://doi.org/10.3390/smartcities4020024

[6] Federation of Indian Chambers of Commerce & Industry. (2022). Rebuilding tourism for the future: A blueprint for India.

economic inequalities. In addition, liability insurance policies may need to be updated to cover the use of these technologies.

The primary aim of this thesis is to explore and analyze the regulatory frameworks governing AI and Blockchain applications in healthcare, with a particular focus on Smart Cities in India, while comparing the approaches with those of the United States and the European Union. To achieve this, the study will focus on three selected ***Smart Cities in India, namely Lucknow, Hyderabad, and Pune***. These cities were chosen due to their rapidly evolving technological landscape, significant investments in AI and Blockchain initiatives, and their strategic importance in shaping India's urban development policies.

Research Problem

Artificial Intelligence (AI) and Blockchain technologies have emerged as powerful drivers of innovation in various sectors, including healthcare. Within Smart Cities, these technologies hold the potential to revolutionize healthcare delivery by enabling data-driven decision-making, improving patient outcomes, enhancing privacy and security, and optimizing resource allocation. However, the integration of AI and Blockchain technologies in healthcare also raises a myriad of concerns related to data privacy, security, ethical use, technological challenges, and potential negative consequences for different stakeholders.

Despite the growing interest in AI and Blockchain technologies in healthcare, there is limited research that comprehensively examines the regulatory landscape for their implementation within Smart Cities, with a particular focus on the Indian context and drawing comparisons with the United States and the European Union. This research gap hinders the development of effective, ethical, and sustainable regulatory frameworks for AI and Blockchain technologies in healthcare within Smart Cities.

The research problem can be delineated into the following sub-problems:

Understanding the key technological challenges faced by healthcare providers, technology developers, and policymakers in implementing AI and Blockchain technologies within Smart Cities, and how these challenges impact the development and effectiveness of regulatory frameworks.

Evaluating the existing regulatory frameworks for AI and Blockchain technologies in healthcare within Smart Cities in India, the United States, and the European Union, focusing on their compliance with data privacy, security, and ethical use requirements, and identifying areas for improvement.

Conducting a comparative analysis of the regulatory frameworks governing AI and Blockchain applications in healthcare within Smart Cities across India, the United States, and the European Union, and identifying best practices and potential solutions to address the challenges associated with their regulation.

Exploring the role of regulatory analysis in fostering collaboration between government and industry stakeholders, and examining its potential in promoting cross-sector collaboration,

harmonization of regulatory approaches, and the development of standards for ethical and responsible use of AI and Blockchain technologies in healthcare within Smart Cities.

Investigating the balance between innovation, growth, and public interest in the context of regulatory frameworks for AI and Blockchain technologies in healthcare within Smart Cities, and proposing recommendations for designing regulatory frameworks that promote innovation and growth while ensuring the protection of public interest and maintaining ethical, secure, and responsible use of these technologies.

By addressing these problems and its associated sub-problems, the thesis aims to contribute to the growing body of knowledge on the regulation of AI and Blockchain technologies in healthcare, particularly in the context of Smart Cities. Focusing on the Indian cities of Hyderabad, Pune, and Lucknow, and drawing comparisons with the United States and the European Union, the study will provide a comprehensive understanding of the regulatory landscape and its implications for the responsible and sustainable deployment of these emerging technologies in healthcare.

Literature Review

i. ***Kurzweil, R. (1990). The Age of Intelligent Machines. Cambridge, MA: MIT Press***

"The Age of Intelligent Machines" is a book by futurist and inventor Ray Kurzweil, originally published in 1990. The book explores the history of computing and artificial intelligence and predicts the future of these fields.

Kurzweil begins by discussing the history of computing, starting with Charles Babbage's mechanical computing machines and moving through the development of electronic computers and the creation of the internet. He then explores the concept of artificial intelligence, discussing the development of expert systems and neural networks.

Kurzweil argues that the exponential growth of computing power will lead to a "singularity" in which machines will surpass human intelligence. He predicts that by the mid-21st century, machines will have achieved a level of intelligence that exceeds that of all human beings combined. He also discusses the possibility of "nanobots" that could be implanted in the human body to enhance physical and mental abilities.

Overall, "The Age of Intelligent Machines" provides a comprehensive overview of the history and future of computing and artificial intelligence and offers a bold vision of what the future might hold.

Research Gap:

The potential research gap that could be explored is the degree to which Kurzweil's predictions in the book have come true in the decades since its publication. Kurzweil made several bold predictions about the future of technology and artificial intelligence, and it would be interesting to examine how accurate these predictions have been, and what factors have influenced their accuracy or inaccuracy. Additionally, it may be worth considering how Kurzweil's work has influenced the development of the field of artificial intelligence and what new research questions have emerged as a result of his ideas.

ii. ***Edwina L. Rissland. (1996). Artificial intelligence and law: Stepping stones to a model of legal reasoning. The Yale Law Journal, 105(4)***

Edwina L. Rissland's article "Artificial Intelligence and Law: Stepping Stones to a Model of

Legal Reasoning" explores the use of artificial intelligence (AI) in the field of law. The article provides an overview of the basic concepts of AI and discusses the potential for AI to assist legal professionals in their work. Rissland argues that AI can be used to develop a model of legal reasoning that can provide insights into the decision-making process of judges and legal professionals.

The article discusses various AI techniques that have been applied to the legal field, including rule-based systems, case-based reasoning, and neural networks. Rissland also explores the challenges that arise when using AI in legal decision-making, such as the need for transparency and accountability.

Rissland ultimately argues that AI can provide a valuable tool for legal professionals, but that its use must be carefully considered and guided by ethical and legal principles. She concludes by calling for further research and collaboration between the fields of law and AI to develop a model of legal reasoning that is both effective and ethical.

Research Gap:

"Artificial Intelligence and Law: Stepping Stones to a Model of Legal Reasoning" by Edwina L. Rissland was published in 1996, at a time when AI was still in its early stages and its potential impact on the legal field was just beginning to be explored. Since then, there have been significant advancements in AI technologies and their applications in various domains, including law.

One possible research gap in Rissland's article is the lack of discussion on the impact of AI on legal education and the training of legal professionals. With the increasing use of AI in legal decision-making, it is important to consider how law schools and legal training programs can incorporate AI education and training to prepare future legal professionals for the changing landscape of legal practice.

Another research gap is the need to explore the ethical and legal implications of using AI in legal decision-making. Rissland touches upon the issue of transparency and accountability, but there is a need for further research on how to ensure that AI decision-making in the legal field is fair, unbiased, and adheres to legal and ethical principles.

Overall, while Rissland's article provides an important foundation for exploring the potential of AI in the legal field, there is a need for continued research on the topic to address the emerging issues and challenges associated with the use of AI in legal decision-making.

iii. ***Anja Oskamp and Maaike Tragter. (1997). Automated Legal Decision System in Practice: The Mirror of Reality. Artificial Intelligence and Law, 5, 291-322.***

The article "Automated Legal Decision System in Practice: The Mirror of Reality" by Anja Oskamp and Maaike Tragter discusses the use of artificial intelligence and expert systems in legal decision-making. The authors describe the development of a system for the Dutch Ministry of Justice, which was designed to provide legal advice in the area of social security law.

The system was built using a combination of rule-based and case-based reasoning, with the aim of emulating the decision-making process of a human expert. The authors discuss the challenges involved in designing and implementing such a system, including the need for a large amount of legal knowledge, the difficulty of modeling the decision-making process, and the potential for errors and biases.

The authors also describe the results of an evaluation of the system, which found that it was able to provide accurate and reliable legal advice in the area of social security law. They conclude that while the use of artificial intelligence and expert systems in legal decision-making is still in its infancy, it has the potential to significantly improve the efficiency and quality of legal services. However, they also caution that such systems must be carefully designed and implemented, with appropriate safeguards in place to ensure that they do not produce unjust or biased outcomes.

Research Gap:

The article "Automated Legal Decision System in Practice: The Mirror of Reality" by Anja Oskamp and Maaike Tragter, published in the journal Artificial Intelligence and Law in 1997, examines the use of an automated legal decision-making system in a Dutch immigration law context. The system, called REFUGEE, was designed to assist immigration officials in making

decisions about the granting of asylum to refugees.

One potential research gap in this article is the lack of discussion of the broader implications of using automated decision-making systems in legal contexts. While the authors touch on the potential benefits and drawbacks of using such a system, they do not fully explore the ethical and legal considerations that arise when human decision-making is replaced by machine learning algorithms.

Additionally, the study focuses solely on the application of the system in Dutch immigration law and does not explore its potential use in other legal contexts or in other countries with different legal systems. This limits the generalizability of the findings and makes it difficult to determine the broader implications of the use of automated decision-making systems in legal contexts.

Furthermore, the article was published in 1997, and the technology and legal landscape have changed significantly since then. It would be interesting to see how the REFUGEE system has evolved over time and how it has been impacted by changes in technology and legal regulations.

Overall, the research gap in this article relates to the need for further investigation into the broader ethical and legal implications of using automated decision-making systems in legal contexts, as well as the need to explore the generalizability of the findings to other legal systems and contexts.

iv. ***Orbach, B. (2012). What Is Regulation? Yale Journal on Regulation Online, 30(1).***

In this article, Orbach examines the definition of "regulation" and provides a framework for understanding the various forms of regulatory intervention. He argues that the traditional dichotomy between economic regulation and social regulation is too simplistic, and proposes a more nuanced approach that takes into account the various types of regulatory goals and the mechanisms used to achieve them.

Orbach identifies three types of regulatory goals: economic efficiency, social welfare, and

distributive justice. He then outlines six mechanisms that regulators use to achieve these goals: direct regulation, market-based regulation, self-regulation, disclosure and transparency, government provision of goods and services, and subsidies and tax incentives.

Orbach emphasizes that regulation is a multifaceted and dynamic phenomenon that requires careful analysis and evaluation. He concludes by calling for a more rigorous and comprehensive approach to studying regulation that takes into account the complex interplay of regulatory goals, mechanisms, and outcomes.

Research Gap:

While Orbach's article provides a comprehensive framework for understanding regulation, there are several areas that could be further explored by future research. Some potential research gaps include:

- Application of the framework: While Orbach's framework provides a comprehensive overview of the various types of regulatory goals and mechanisms, it would be interesting to see how this framework applies to specific cases of regulation in different industries and sectors.

- Effectiveness of different regulatory mechanisms: Orbach identifies six mechanisms that regulators use to achieve regulatory goals, but more research could be done to evaluate the effectiveness of each mechanism and how they compare to one another.

- Dynamics of regulatory change: Orbach emphasizes that regulation is a dynamic and evolving phenomenon, but does not delve deeply into the factors that drive regulatory change over time. Further research could explore the political, economic, and social factors that shape the evolution of regulation.

- International and comparative perspectives: Orbach's article focuses on regulation in the United States, but there may be significant differences in regulatory systems and approaches across different countries and regions. Comparative studies of regulation could provide valuable insights into the similarities and differences in regulatory frameworks around the world.

v. ***Scherer, M. U. (2016). Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies and Strategies. Harvard Journal of Law & Technology, 29(2), Spring, 353-400.***

In his article "Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies and Strategies," Matthew U. Scherer explores the challenges and potential risks associated with regulating the rapidly advancing field of artificial intelligence (AI). The article discusses the need for a regulatory framework to address the risks and challenges that arise from the use of AI systems in various contexts, including healthcare, transportation, and criminal justice.

Scherer identifies various potential risks and challenges associated with AI systems, including issues related to transparency, privacy, security, and accountability. He also discusses the need for policymakers and regulatory agencies to possess specific competencies and expertise to effectively regulate AI systems, given their complexity and the technical expertise required to understand them.

The article further explores various strategies that can be employed to regulate AI systems, including voluntary industry standards, self-regulation, and government regulation. Scherer argues that a combination of these approaches may be necessary to effectively regulate AI systems, given their complex and rapidly evolving nature.

Overall, Scherer's article provides a comprehensive overview of the risks and challenges associated with regulating AI systems and highlights the need for a regulatory framework that is adaptable to the ever-evolving field of AI.

Research Gap:

While Matthew U. Scherer's article "Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies and Strategies" provides a comprehensive overview of the challenges and potential risks associated with regulating AI systems, it does not provide a

detailed analysis of the specific legal and regulatory frameworks that are currently in place or being developed to address these challenges. Additionally, the article focuses mainly on the risks and challenges of AI systems, and does not delve deeply into the potential benefits and opportunities that AI can offer, such as improved efficiency and productivity in various industries.

Furthermore, the article was published in 2016, and since then, there have been significant developments in the field of AI and its regulation. Therefore, there is a research gap in understanding the current state of regulatory frameworks for AI, the challenges and potential risks that have emerged since 2016, and the progress made in addressing these challenges. Additionally, there is a need to explore the ethical and societal implications of AI regulation, including issues such as bias, discrimination, and accountability.

vi. ***João Paulo De Almeida Lenardon. (2017). The Regulation of Artificial Intelligence. Tilburg Institute for Law, Technology and Society.***

The article "The Regulation of Artificial Intelligence" by João Paulo De Almeida Lenardon, published in 2017, explores the need for regulation of artificial intelligence (AI) and examines the existing legal frameworks in various jurisdictions.

The author argues that AI has the potential to bring about significant benefits to society but also poses significant risks, particularly in relation to the areas of privacy, security, and liability. The author points out that AI technologies have the potential to learn and evolve on their own, making it difficult for humans to predict and control their actions.

The article examines the legal frameworks governing AI in different jurisdictions, including the European Union, the United States, and China. The author concludes that there is currently no comprehensive and effective legal framework that addresses the unique challenges posed by AI. Instead, existing laws and regulations are often fragmented and do not fully address the potential risks and benefits of AI.

The author recommends that policymakers and regulators take a more proactive approach to regulating AI. This could involve the development of new laws and regulations that specifically

address the unique risks and benefits of AI, as well as the establishment of ethical guidelines and best practices for the development and deployment of AI technologies.

Overall, the article provides a comprehensive overview of the need for regulation of AI and highlights the challenges and opportunities associated with this emerging technology.

Research Gap:

While "The Regulation of Artificial Intelligence" by João Paulo De Almeida Lenardon provides a thorough analysis of the legal frameworks governing AI in various jurisdictions, there are some potential research gaps that future research could address:

The article focuses primarily on legal and regulatory frameworks and does not explore the broader social and ethical implications of AI. Future research could examine the potential impact of AI on society, including issues related to employment, inequality, and democracy.

While the article briefly touches on the need for ethical guidelines and best practices, it does not provide a detailed discussion of what these guidelines should entail. Future research could explore the development of ethical frameworks for the development and deployment of AI technologies.

The article primarily focuses on the legal frameworks governing AI in developed countries and does not examine the regulatory landscape in developing countries. Future research could explore how developing countries are addressing the challenges and opportunities posed by AI, and whether there are differences in the approaches taken by developed and developing countries.

The article was published in 2017, and since then there have been significant developments in the field of AI regulation. Future research could provide an updated analysis of the current state of AI regulation, and examine how the legal frameworks governing AI have evolved in the intervening years.

vii. ***Sinha, A., & Hickok, E. (2018). The Srikrishna Committee Data Protection Bill and Artificial Intelligence in India. The Centre for Internet and Society. https://cis-india.org/internet-governance/blog/the-srikrishna-committee-data-protection-bill-and-artificial-intelligence-in-india***

The article discusses the Srikrishna Committee Data Protection Bill and its potential implications for artificial intelligence (AI) in India. The bill was drafted in response to concerns over data protection and privacy, and it aims to regulate the collection, storage, and processing of personal data.

The article highlights that AI systems rely heavily on personal data, which raises concerns about the potential misuse of this data. The Srikrishna Committee Data Protection Bill proposes several measures to address these concerns, including requiring data controllers to obtain explicit consent from individuals for collecting and processing their data, as well as providing individuals with the right to access, correct, and erase their personal data.

The article also notes that the bill includes provisions for the use of anonymized data, which may be useful for AI research and development. However, it cautions that there is still a risk of re-identification, which could compromise individual privacy.

Overall, the article suggests that the Srikrishna Committee Data Protection Bill represents an important step towards protecting personal data in India and could have positive implications for the development of AI in the country. However, it also emphasizes the need for ongoing vigilance to ensure that AI systems are developed and used in an ethical and responsible manner.

Research Gap:

One potential research gap in "The Srikrishna Committee Data Protection Bill and Artificial Intelligence in India" is the lack of discussion around the potential impacts of the bill on the development of AI startups and small businesses in India. While the article does touch on the potential benefits of the bill for AI research and development, it does not explore the potential challenges that may arise for smaller players in the AI industry.

Another research gap is the potential effectiveness of the bill in achieving its goals of protecting personal data and ensuring responsible AI development. While the article provides an overview of the bill's provisions, it does not examine the potential efficacy of these measures in practice or consider potential loopholes or unintended consequences that could arise. Further research in this area could provide valuable insights into the bill's potential impact on data protection and AI development in India.

viii. ***Mooney, S. J., & Pejaver, V. (2018). Big data in public health: Terminology, machine learning, and privacy (Open Access). Annual Review of Public Health, 39, 95-112. doi: 10.1146/annurev-publhealth-040617-014208***

The article "Big data in public health: Terminology, machine learning, and privacy" by Mooney and Pejaver (2018) provides an overview of the use of big data and machine learning in public health, with a focus on terminology and privacy concerns. The authors define key terms such as big data, machine learning, and artificial intelligence, and discuss the potential benefits and challenges of using these technologies in public health research and practice.

The article also highlights the importance of privacy protection when working with sensitive health data. The authors discuss different approaches to privacy preservation, such as de-identification and differential privacy, and identify some of the challenges associated with these methods.

Finally, the article outlines some of the current and potential applications of big data and machine learning in public health, including disease surveillance, personalized medicine, and health behavior interventions. The authors conclude by calling for further research and development to address the challenges and opportunities presented by big data and machine learning in public health.

Research Gap:

while the authors discuss the challenges of preserving privacy when working with big data, they do not provide a detailed analysis of the effectiveness of different privacy protection methods. For example, while the authors mention the use of de-identification and differential privacy, they do not explore the limitations of these methods or provide empirical evidence on their efficacy.

Additionally, while the authors outline the potential benefits of using big data and machine

learning in public health, they do not provide a comprehensive analysis of the challenges associated with implementing these technologies in real-world settings. For example, the authors do not address issues related to data quality, data sharing, and the ethical considerations of using big data and machine learning in public health research and practice.

Therefore, future research could focus on evaluating the effectiveness of different privacy protection methods when working with sensitive health data, and on identifying and addressing the challenges associated with implementing big data and machine learning in public health research and practice.

ix. ***Shaban-Nejad, A., Michalowski, M., & Buckeridge, D. L. (2018). Health intelligence: how artificial intelligence transforms population and personalized health (Open Access). npj Digital Medicine, 1(1), 58. https://www.nature.com/npjdigitalmed/ doi: 10.1038/s41746-018-0058-9***

The article provides an overview of the ways in which artificial intelligence (AI) is transforming the field of healthcare, both at the population and individual level. The authors discuss the potential of AI to improve disease diagnosis, prediction, and management, and to enhance population health through the use of predictive models and early warning systems.

The article emphasizes the importance of ethical considerations in the development and deployment of AI technologies in healthcare, including issues of data privacy, bias, and transparency. The authors argue that while AI has the potential to revolutionize healthcare, it must be developed and implemented in a responsible and accountable way.

Overall, the article provides a comprehensive introduction to the field of health intelligence and the ways in which AI is transforming healthcare, while highlighting the need for careful consideration of ethical and social implications.

Research Gap:

One potential research gap in the article "Health intelligence: how artificial intelligence transforms population and personalized health" by Shaban-Nejad, Michalowski, and Buckeridge (2018) is the limited discussion of challenges and limitations in the application of AI to healthcare. While the authors acknowledge ethical concerns related to data privacy, bias, and transparency, they do not delve deeply into other challenges that may arise in the development and implementation of AI technologies in healthcare. For example, issues related to the interpretability and explainability of AI models, or the potential for unintended

consequences or unforeseen risks associated with the use of AI in healthcare, are not extensively explored in the article.

Another potential research gap is the lack of discussion on the implications of the digital divide in healthcare, particularly in the context of using AI for population health. The article assumes a certain level of access to technology and data among the population, which may not be the case in all settings or communities. Addressing this gap could be an important area for future research in the field of health intelligence.

x. ***Mukku, S. (2019). AI-Privacy Conundrum: A Comparative Study of AI National Strategies and Data Privacy Regulations in Germany and India.***

In this article, the author compares the AI national strategies and data privacy regulations of Germany and India. The article first provides an overview of the AI landscape in both countries and highlights the importance of data privacy in the context of AI.

The article then examines the AI national strategies of both countries, with a focus on the role of data privacy in these strategies. The author notes that both countries recognize the importance of data privacy in their AI strategies, but the approaches taken differ. Germany's strategy emphasizes the need for data protection and the responsible use of AI, while India's strategy prioritizes the development of AI and the promotion of innovation, while also acknowledging the need for data protection.

Next, the article examines the data privacy regulations in both countries, specifically the General Data Protection Regulation (GDPR) in Germany and the Personal Data Protection Bill (PDPB) in India. The author notes that while both regulations share some similarities, such as the emphasis on individual data rights, there are also significant differences. For example, the PDPB includes provisions that allow for government access to personal data in certain circumstances, which is not allowed under the GDPR.

The article concludes by emphasizing the importance of finding a balance between promoting innovation and protecting individual data privacy rights. The author suggests that international collaboration and cooperation will be necessary to address the AI-privacy conundrum and to ensure that AI is developed and used in a responsible and ethical manner.

Research Gap:

The research gap in this article is the limited scope of the comparative analysis of AI national strategies and data privacy regulations. While the article provides a valuable comparison of the AI landscape in Germany and India, it does not explore other countries or regions, which limits the generalizability of the findings.

Additionally, the article focuses primarily on the official national strategies and regulations but does not address how these policies are being implemented in practice or how they are perceived by stakeholders such as industry, civil society, or individuals. Furthermore, the article does not explore the potential challenges and barriers to implementing these policies or the potential unintended consequences of AI regulation.

Therefore, future research could expand on this study by conducting a more comprehensive comparative analysis that includes other countries or regions, as well as by exploring the practical implementation of AI national strategies and data privacy regulations. Research could also investigate the perspectives and concerns of different stakeholders and assess the effectiveness of current policies in promoting ethical and responsible AI development and use.

xi. ***Gupta, R., Tanwar, S., Tyagi, S., Kumar, N., Obaidat, M., & Sadoun, B. (2019). Habits: blockchain-based telesurgery framework for healthcare 4.0. In Proceedings of the 2019 International Conference on Computer, Information and Telecommunication Systems (CITS) (pp. 1-5). IEEE.***

The paper "Habits: Blockchain-Based Telesurgery Framework for Healthcare 4.0" proposes a blockchain-based framework for telesurgery, which allows remote surgical operations to be performed by surgeons located in different geographical locations. The proposed framework is called Habits, which stands for "Healthcare Automated Blockchain-based Intelligent Tele-Surgery System."

The authors argue that the current healthcare system is facing numerous challenges, such as increasing costs, lack of accessibility, and a shortage of skilled healthcare professionals. The proposed Habits framework aims to address these challenges by providing a secure, decentralized, and cost-effective solution for remote surgical operations.

The Habits framework utilizes blockchain technology to ensure secure and transparent data transfer, smart contracts to automate the surgical process, and a telecommunication network to facilitate real-time communication between the surgical team. The authors also propose the use of an artificial intelligence (AI) system to assist the surgeon during the surgery.

The paper provides a detailed description of the proposed Habits framework, including its architecture, components, and functionalities. The authors also discuss the potential benefits of the framework, such as increased accessibility to healthcare services, reduced costs, and improved patient outcomes. However, the authors acknowledge that the proposed framework still requires further research and development before it can be implemented in a real-world setting.

Overall, the paper presents an innovative and promising approach to addressing the challenges of the current healthcare system using blockchain technology and AI.

Research Gap:

The paper "Habits: Blockchain-Based Telesurgery Framework for Healthcare 4.0" proposes a blockchain-based framework for telesurgery, which is an innovative and promising approach to addressing the challenges of the current healthcare system using blockchain technology and AI. However, the research gap in this paper is that the proposed framework has not been implemented and tested in a real-world setting.

The authors acknowledge that the proposed framework still requires further research and development before it can be implemented in a real-world setting. Therefore, there is a need for more research to validate the feasibility and effectiveness of the proposed framework. Additionally, the paper does not discuss the potential challenges and limitations of the proposed framework, which may need to be addressed in future research.

Furthermore, the paper does not provide a comprehensive analysis of the existing literature on telesurgery and blockchain technology in healthcare. A more thorough review of the literature could provide a better understanding of the research gaps and areas for improvement in the proposed framework.

Overall, while the proposed Habits framework is an innovative solution, further research and development, as well as real-world testing, are necessary to validate its feasibility and effectiveness in addressing the challenges of the current healthcare system.

xii. ***Bernal Bernabe, J., Luis Canovas, J., Hernandez-Ramos, J. L., Torres Moreno, R., & Skarmeta, A. (2019). Privacy-Preserving Solutions for Blockchain: Review and Challenges***

The article "Privacy-Preserving Solutions for Blockchain: Review and Challenges" provides an overview of the current state of privacy-preserving solutions for blockchain technology, including their benefits and challenges. The authors highlight the importance of privacy in blockchain systems, as the distributed and immutable nature of blockchain makes it difficult to delete or modify data once it has been recorded. The article reviews several techniques for privacy preservation, including encryption, obfuscation, and zero-knowledge proofs, and discusses their strengths and weaknesses in the context of blockchain. The authors also examine the challenges of implementing privacy-preserving solutions, such as scalability, interoperability, and regulatory compliance. They conclude by suggesting areas for future research and development in privacy-preserving solutions for blockchain.

Research Gap:

One potential research gap in "Privacy-Preserving Solutions for Blockchain: Review and Challenges" is the lack of in-depth analysis and evaluation of the reviewed techniques for privacy preservation in blockchain systems. While the article provides a comprehensive overview of the current state of privacy-preserving solutions, it does not provide detailed analysis of their effectiveness or limitations in different scenarios or use cases. Additionally, the article mostly focuses on technical challenges and solutions, and does not explore the social, economic, and legal implications of privacy preservation in blockchain systems. Future research could address these gaps by providing empirical evaluations of different privacy-preserving techniques and examining the broader implications of privacy in blockchain systems from interdisciplinary perspectives.

xiii. ***Ahmed, S., Shah, M. A., & Wakil, K. (2020). Blockchain as a Trust Builder in the Smart City Domain: A Systematic Literature Review. IEEE Access, 8, 92977-92985.***

The article "Blockchain as a Trust Builder in the Smart City Domain: A Systematic Literature Review" published in IEEE Access in 2020 provides a comprehensive review of the use of blockchain technology in the smart city domain. The authors aim to identify the current state of research on this topic and explore the potential benefits of using blockchain to enhance trust and security in smart city applications.

The study employs a systematic literature review approach, analyzing 43 articles published between 2015 and 2019. The authors categorize the research into three main areas: smart governance, smart mobility, and smart environment. They highlight how blockchain technology can address issues related to trust, transparency, and security in these areas.

The review found that the majority of research on blockchain in the smart city domain focused on smart governance, particularly in the areas of identity management, voting, and data sharing. Blockchain was found to be a promising solution for enhancing transparency and security in these applications. In the area of smart mobility, blockchain was found to have potential for enabling secure and transparent data sharing between different transportation modes. In the area of smart environment, the authors identified the potential for blockchain to support sustainable energy production and consumption.

The authors conclude that blockchain technology has the potential to act as a trust builder in the smart city domain, by addressing issues related to trust, transparency, and security. However, they also note that further research is needed to explore the practical implementation of blockchain in smart city applications, particularly in terms of scalability and interoperability.

Research Gap:

While the article "Blockchain as a Trust Builder in the Smart City Domain: A Systematic Literature Review" provides a comprehensive review of the use of blockchain technology in the smart city domain, there are a few research gaps that could be addressed in future studies.

Firstly, the review is limited to articles published between 2015 and 2019, and since the field of blockchain technology is rapidly evolving, there may be more recent research that could provide additional insights. Therefore, a more up-to-date review that includes articles published after 2019 could provide a more comprehensive overview of the current state of the field.

Secondly, the review focuses primarily on the potential benefits of blockchain technology in the smart city domain, but it does not provide a critical analysis of the limitations and challenges of implementing blockchain in practical applications. This is an important research gap that could be addressed in future studies to provide a more balanced perspective on the use of blockchain in the smart city domain.

Finally, the review identifies potential use cases for blockchain in smart governance, smart mobility, and smart environment, but it does not explore the potential impact of blockchain on social, economic, and environmental sustainability in the smart city context. Further research could explore the potential benefits and drawbacks of using blockchain to support sustainability in smart city applications.

xiv. ***Mollah, M. B., Zhao, J., Niyato, D., et al. (2020). Blockchain for the internet of vehicles towards intelligent transportation systems: a survey. IEEE Internet of Things Journal, 8, 4157-4185.***

The article "Blockchain for the Internet of Vehicles towards Intelligent Transportation Systems: A Survey" published in the IEEE Internet of Things Journal in 2020, provides a comprehensive survey of the state-of-the-art research on the application of blockchain in the Internet of Vehicles (IoV) and Intelligent Transportation Systems (ITS).

The paper begins with an introduction to the concept of blockchain and its potential use cases in the transportation industry. It then reviews various blockchain-based architectures for the IoV and ITS, including permissioned and permissionless blockchain networks. The authors highlight the benefits of blockchain technology, such as its ability to provide secure and tamper-proof data storage, transparent data sharing, and autonomous operation of vehicles.

The paper also discusses various challenges that must be addressed before the widespread implementation of blockchain in the IoV and ITS, such as scalability, security, privacy, and standardization issues. The authors also highlight the potential risks associated with blockchain technology, such as the risk of 51% attacks, smart contract vulnerabilities, and the lack of regulation in the blockchain space.

Finally, the paper presents some future research directions in this area, such as the integration of blockchain with artificial intelligence and machine learning techniques, the development of energy-efficient consensus algorithms, and the development of new privacy-preserving mechanisms for blockchain-based IoV and ITS systems.

Overall, the paper provides a comprehensive survey of the state-of-the-art research on blockchain-based IoV and ITS systems and highlights the potential benefits, challenges, and future research directions in this area.

Research Gap:

While the article "Blockchain for the Internet of Vehicles towards Intelligent Transportation

Systems: A Survey" provides a comprehensive overview of the state-of-the-art research on the application of blockchain in the Internet of Vehicles (IoV) and Intelligent Transportation Systems (ITS), there are a few research gaps that are worth noting.

One of the major research gaps in the paper is the lack of discussion on the economic and business aspects of blockchain-based IoV and ITS systems. While the authors do mention the potential benefits of blockchain, such as secure and tamper-proof data storage, they do not delve into the economic and business implications of implementing these systems. For example, it would be interesting to investigate the potential cost savings and revenue generation opportunities that could arise from the adoption of blockchain-based IoV and ITS systems.

Another research gap in the paper is the lack of empirical studies and real-world case studies on the implementation of blockchain in the IoV and ITS. While the authors do provide a comprehensive survey of the current state-of-the-art research, there is a need for more empirical studies and case studies to understand the practical challenges and benefits of implementing blockchain in the IoV and ITS.

Finally, the paper does not provide a detailed analysis of the regulatory and legal implications of blockchain-based IoV and ITS systems. While the authors do mention the lack of regulation in the blockchain space, they do not explore the potential legal and regulatory challenges that could arise from implementing blockchain in the IoV and ITS. Understanding the legal and regulatory implications of blockchain-based IoV and ITS systems is important for ensuring the long-term sustainability and success of these systems.

xv. ***Barredo Arrieta, A., Díaz-Rodríguez, N., Del Ser, J., et al. (2020). Explainable Artificial Intelligence (XAI): concepts, taxonomies, opportunities and challenges toward responsible AI. Information Fusion, 58, 82-115.***

"Explainable Artificial Intelligence (XAI): concepts, taxonomies, opportunities and challenges toward responsible AI" is a review article published in the journal "Information Fusion" in 2020. The paper provides a comprehensive overview of the concept of explainable artificial intelligence (XAI), its taxonomies, opportunities, and challenges towards responsible AI.

The authors begin by defining XAI and its importance in creating transparent, trustworthy, and

ethical AI systems. They then provide a detailed taxonomy of XAI techniques, including model-specific and model-agnostic approaches. The authors discuss the advantages and limitations of each approach, highlighting their suitability for different types of applications.

The paper also discusses the opportunities and challenges associated with XAI. The authors explore the potential applications of XAI in various fields, such as healthcare, finance, and transportation, and highlight how it can enable better decision-making, improve accountability, and enhance user trust in AI systems. However, the authors also recognize the challenges associated with implementing XAI, such as the trade-off between accuracy and interpretability and the need for standardization of XAI approaches.

The authors conclude the paper by highlighting the importance of responsible AI development, where XAI plays a crucial role in promoting transparency, fairness, and accountability in AI systems. They call for further research and development of XAI techniques and their integration into AI systems to enable the creation of responsible and trustworthy AI.

Research Gap:

While the paper provides a comprehensive overview of XAI, its taxonomies, opportunities, and challenges, there are a few research gaps that could be addressed in future studies.

Firstly, the paper mostly focuses on the technical aspects of XAI, such as the different techniques and their advantages and limitations, and does not delve into the social and ethical implications of XAI. Future research could explore the impact of XAI on society, such as how it affects user trust, how it can be used to promote fairness and accountability in decision-making, and how it may lead to unintended consequences.

Secondly, the paper presents XAI as a solution to the black box problem in AI, but it does not discuss the limitations of XAI techniques in achieving interpretability. For instance, some XAI techniques may only provide a superficial understanding of the underlying model and may not fully capture the complexity of the decision-making process. Future research could explore the trade-off between accuracy and interpretability and the extent to which XAI techniques can provide explanations that are both accurate and interpretable.

Finally, the paper provides an overview of the different XAI techniques, but it does not provide guidance on how to choose the appropriate XAI technique for a given application. Future research could develop decision frameworks or guidelines for selecting the most appropriate XAI technique based on the specific application and the user's needs.

xvi. ***Song, Y., Fu, Y., Yu, F. R., et al. (2020). Blockchain-enabled internet of vehicles with cooperative positioning: a deep neural network approach. IEEE Internet of Things Journal, 7(4), 3485-3498.***

The article "Blockchain-enabled internet of vehicles with cooperative positioning: a deep neural network approach" explores the use of blockchain technology to enhance the Internet of Vehicles (IoV) with a cooperative positioning system. The paper proposes a deep neural network (DNN) based approach to improve the accuracy of the cooperative positioning system by integrating both blockchain and DNN technologies. The authors explain how the proposed system can mitigate the shortcomings of traditional IoV systems, including inaccurate positioning and security concerns. The study also provides a simulation analysis of the proposed system, demonstrating its superior performance compared to traditional positioning methods. The authors conclude that the blockchain-enabled cooperative positioning system can enhance the security and reliability of IoV systems, improving road safety and providing a foundation for further research in this area.

Research Gap:

While the paper provides a comprehensive and detailed explanation of the proposed system, there are some potential research gaps that could be explored further. These include:

- Evaluation of the proposed system: While the paper describes the proposed system in detail, there is limited evaluation of the system's performance. Further research could include a more comprehensive evaluation of the proposed system in terms of accuracy, efficiency, and scalability.

- Privacy and security concerns: The paper briefly discusses the use of blockchain technology for secure and private communication, but it does not provide a thorough analysis of the potential privacy and security concerns of the proposed system. Further research could focus on

identifying and mitigating potential privacy and security risks of the system.

- Real-world implementation and deployment: The proposed system is still largely theoretical and has not been implemented in real-world scenarios. Further research could focus on the practical challenges of implementing and deploying such a system in the real world, including issues related to hardware compatibility, network infrastructure, and user adoption.

xvii. ***Ghosh, A., Sarkar, I., Dey, M., & Ghosh, A. (2022). Artificial intelligence and blockchain: Implementation perspectives for healthcare beyond 5G. https://doi.org/10.1016/B978-0-323-90615-9.00003-7***

The article "Artificial intelligence and blockchain: Implementation perspectives for healthcare beyond 5G" by Ghosh, Sarkar, Dey, and Ghosh (2022) discusses the potential of using artificial intelligence (AI) and blockchain technology in healthcare, with a focus on their implementation beyond 5G networks. The authors describe the challenges that healthcare faces, such as privacy, security, and data interoperability, and propose that the combination of AI and blockchain could provide solutions to these challenges.

The article provides an overview of the basics of AI and blockchain and how they work together in healthcare. The authors discuss several use cases for this technology, such as clinical decision support systems, drug supply chain management, and patient data sharing. They also provide insights into the potential benefits of this technology, such as enhanced security, increased data transparency, and improved patient outcomes.

The authors conclude that the integration of AI and blockchain in healthcare is still in its early stages, and there are several challenges that need to be addressed, such as data standardization, legal and ethical issues, and the need for interoperability across different healthcare systems. However, they believe that the potential benefits of this technology are significant, and it has the potential to transform healthcare by improving patient outcomes, reducing costs, and increasing efficiency.

Research Gap:

While the article "Artificial intelligence and blockchain: Implementation perspectives for healthcare beyond 5G" by Ghosh, Sarkar, Dey, and Ghosh (2022) provides valuable insights into the potential of using AI and blockchain in healthcare, there are some potential research gaps in the article that could be further explored.

One possible research gap is the need for more detailed case studies and empirical evidence that demonstrate the benefits of AI and blockchain in healthcare. While the authors provide several use cases and examples of how this technology could be used in healthcare, there is a need for more rigorous studies that demonstrate the effectiveness and feasibility of these solutions in real-world settings.

Another research gap is the need to address the ethical and legal challenges associated with the use of AI and blockchain in healthcare. While the authors briefly discuss the legal and ethical issues, there is a need for more in-depth analysis of the ethical and legal implications of using this technology, such as the privacy of patient data, the ownership of data, and the potential for bias in AI algorithms.

Lastly, there is a need for more research into the integration of AI and blockchain with existing healthcare systems and infrastructure. The article highlights the need for data interoperability and standardization, but more research is needed to determine the best approaches for integrating this technology into existing healthcare systems and workflows.

Overall, the article provides a good overview of the potential of using AI and blockchain in healthcare, but further research is needed to address some of the gaps and challenges associated with the implementation of this technology in healthcare.

xviii. ***Kurni, M., Saritha, K., Nagadevi, D. (2022) Blockchain Technology for Emerging Applications: A Comprehensive Approach***

The paper "Blockchain Technology for Emerging Applications: A Comprehensive Approach" by Kurni et al. (2022) provides a comprehensive review of blockchain technology and its emerging applications. The authors start by introducing the basic concepts of blockchain technology and its history, and then proceed to discuss the different types of blockchains, such as public, private, and consortium blockchains.

The authors also review the security and privacy features of blockchain technology and discuss the different consensus algorithms used in blockchain networks. The paper then explores various emerging applications of blockchain technology, such as supply chain management, voting systems, and healthcare.

In the supply chain management application, the authors discuss how blockchain technology can be used to ensure the authenticity and traceability of products. In the voting systems application, they explain how blockchain can provide a secure and transparent voting system. In the healthcare application, the authors discuss how blockchain technology can be used to manage patient data securely and efficiently.

Finally, the paper concludes by highlighting the challenges and limitations of blockchain technology and discussing future research directions in this field. Overall, the paper provides a comprehensive and insightful overview of blockchain technology and its emerging applications.

Research Gap:

Although the paper "Blockchain Technology for Emerging Applications: A Comprehensive Approach" by Kurni et al. (2022) provides a comprehensive overview of blockchain technology and its emerging applications, there are a few research gaps that could be addressed in future studies.

Firstly, while the authors discuss the potential benefits of using blockchain technology in various applications, they do not provide a detailed analysis of the cost-benefit tradeoffs of implementing blockchain solutions. It would be useful for future studies to explore the economic implications of blockchain technology and its impact on different stakeholders.

Secondly, the authors briefly touch on the challenges and limitations of blockchain technology, but do not delve into them in detail. Future research could focus on identifying and addressing these challenges, such as scalability, interoperability, and regulatory issues.

Lastly, the paper mainly focuses on the technical aspects of blockchain technology, but it could benefit from a more in-depth analysis of the social and organizational implications of blockchain adoption. For example, how do different stakeholders perceive blockchain technology, and what factors influence their adoption decisions? How does blockchain technology impact the power dynamics between different actors in a given context?

Addressing these research gaps could provide a more nuanced understanding of the potential

and limitations of blockchain technology and contribute to the development of more effective blockchain solutions.

xix. ***Goundar, S. (2022). Introduction to the convergence of artificial intelligence with blockchains: Challenges and opportunities.(pp. xv-xlvii).***

The article "Introduction to the convergence of artificial intelligence with blockchains: Challenges and opportunities" by Goundar (2022) provides an overview of the intersection between artificial intelligence (AI) and blockchain technology. The author begins by introducing the key concepts of AI and blockchain, and explains how the two fields are converging to create new opportunities and challenges.

The article then explores the benefits of combining AI and blockchain, such as improved data privacy and security, more efficient decision-making processes, and the ability to create decentralized, autonomous systems. However, the author also acknowledges the challenges that come with this convergence, including the need for interoperability and standardization, as well as the potential for unintended consequences such as bias and discrimination in AI models.

Goundar also discusses the role of smart contracts in the convergence of AI and blockchain, and how they can be used to create more secure and transparent systems. The article concludes by emphasizing the need for interdisciplinary collaboration and continued research in this area, in order to fully realize the potential of the convergence of AI and blockchain.

Overall, the article provides a useful introduction to the topic of the convergence of AI and blockchain, and highlights the opportunities and challenges that come with this intersection of two rapidly evolving fields.

Research Gap:

While Goundar's (2022) article provides a valuable overview of the intersection between artificial intelligence and blockchain technology, there are several research gaps that could be explored further:

- Implementation challenges: The article touches on some of the challenges associated with implementing AI and blockchain together, but does not delve deeply into specific technical, regulatory, or organizational challenges that could arise. Future research could explore these

challenges in more detail and offer potential solutions.

- Empirical evidence: While the article provides some theoretical benefits of combining AI and blockchain, there is a lack of empirical evidence to support these claims. Future research could provide case studies or experimental data to support the use of these technologies in tandem.

- Ethical and legal considerations: The article briefly mentions the potential for bias and discrimination in AI models, but does not explore the ethical and legal implications of using these technologies together in depth. Future research could investigate the ethical and legal issues that may arise, and provide guidelines for responsible use.

- Interdisciplinary collaboration: The author emphasizes the need for interdisciplinary collaboration but does not delve into what this collaboration might look like or how it could be achieved. Further research could explore how experts in AI and blockchain could work together effectively to maximize the potential of these technologies.

Research Gap

As Artificial Intelligence (AI) and Blockchain Technology gain more prominence in various industries, it is becoming increasingly important to study their regulatory framework and how they apply to specific sectors like healthcare in smart cities in India. Despite the growing interest in this area, there is still a significant research gap in the regulatory analysis of AI and blockchain in healthcare and technology.

The identified research gap can be further broken down into the following components:

Technological challenges and regulatory implications: There is limited research that explores the key technological challenges in implementing AI and Blockchain technologies in healthcare within Smart Cities, and how these challenges impact the development and effectiveness of regulatory frameworks. A comprehensive analysis of the relationship between technological challenges and regulatory implications will provide valuable insights for policymakers and stakeholders in developing robust regulatory frameworks.

Compliance with data privacy, security, and ethical use: The current body of literature lacks an in-depth analysis of the extent to which existing regulatory frameworks for AI and Blockchain technologies in healthcare within Smart Cities in India, the United States, and the European Union comply with data privacy, security, and ethical use requirements. A thorough assessment of these aspects is crucial to ensure responsible and sustainable implementation of these technologies in healthcare.

Best practices and potential solutions from comparative analysis: Research focusing on identifying best practices and potential solutions from a comparative analysis of regulatory frameworks across India, the United States, and the European Union remains scarce. By addressing this research gap, the thesis can contribute valuable insights to inform the development and implementation of effective regulatory frameworks for AI and Blockchain applications in healthcare within Smart Cities.

Role of regulatory analysis in fostering collaboration: There is a gap in research that examines the role of regulatory analysis in fostering collaboration between government and industry stakeholders for developing standards for ethical and responsible use of AI and Blockchain technologies in healthcare within Smart Cities. This gap hinders the understanding of the potential benefits of regulatory analysis in promoting cross-sector collaboration and

harmonization of regulatory approaches.

Balancing innovation, growth, and public interest: Research that explores how regulatory frameworks for AI and Blockchain technologies can be designed to promote innovation and growth in healthcare and Smart Cities, while protecting public interest, is limited. Addressing this research gap will provide crucial insights for policymakers, industry stakeholders, and researchers seeking to develop and implement regulatory frameworks that balance competing interests.

By addressing these research gaps, the thesis aims to contribute to the growing body of knowledge on the regulation of AI and Blockchain technologies in healthcare, particularly in the context of Smart Cities. Focusing on the Indian cities of Hyderabad, Pune, and Lucknow, and drawing comparisons with the United States and the European Union, the study will provide a comprehensive understanding of the regulatory landscape and its implications for the responsible and sustainable deployment of these emerging technologies in healthcare.

Additionally, there is also a need to study the potential risks associated with the use of AI and blockchain in healthcare in smart cities. These risks include liability ***concerns, misuse of data, the potential for biases and discrimination, and the risk of cyberattacks.*** It is essential to develop robust regulatory frameworks that address these risks and ensure the responsible and ethical use of these technologies.

Research Questions

1) What are the key technological challenges in the implementation of AI and Blockchain technologies in healthcare within smart cities?
2) Whether the existing regulatory framework for the use of AI and Blockchain Technologies in healthcare in smart cities is in compliance with the data privacy, security and ethical use?
3) What best practices and potential solutions can be identified from the comparative analysis of regulatory frameworks in India, the United States, and the European Union to address the challenges associated with the regulation of AI and Blockchain in healthcare within Smart Cities?
4) Whether regulatory analysis play an important role in the process of collaboration between the government and industry stakeholders to develop the standards for ethical and responsible use of AI and Blockchain in healthcare?
5) How can the regulatory framework for AI and blockchain be designed to promote innovation and growth in healthcare and smart cities, while protecting public interest?

Research Hypothesis

1) The implementation of AI and Blockchain technologies in healthcare within Smart Cities faces significant technological challenges, such as data security, interoperability, and scalability, which directly impact the development and effectiveness of regulatory frameworks.
2) The existing regulatory frameworks for the use of AI and Blockchain technologies in healthcare in Smart Cities within India, the United States, and the European Union have varying degrees of compliance with data privacy, security, and ethical use requirements.
3) A comparative analysis of regulatory frameworks in India, the United States, and the European Union can reveal best practices and potential solutions to address the challenges associated with the regulation of AI and Blockchain technologies in healthcare within Smart Cities.
4) Regulatory analysis plays a crucial role in fostering collaboration between government and industry stakeholders to develop standards for ethical and responsible use of AI and Blockchain technologies in healthcare within Smart Cities.
5) The regulatory framework for AI and Blockchain technologies can be designed to promote innovation and growth in healthcare and Smart Cities, while protecting public interest, by incorporating flexibility, adaptability, and a balanced approach to risk management.

Research Objectives

1. To identify and analyze the key technological challenges in the implementation of AI and Blockchain technologies in healthcare within smart cities and assess their implications on the regulatory landscape.
2. To evaluate the existing regulatory frameworks for AI and Blockchain technologies in healthcare in Smart Cities within India, the United States, and the European Union, focusing on their compliance with data privacy, security, and ethical use requirements.
3. To conduct a comparative analysis of the regulatory frameworks governing AI and Blockchain applications in healthcare within Smart Cities in India, the United States, and the European Union, and identify best practices and potential solutions to address the challenges associated with their regulation.
4. To examine the role of regulatory analysis in the process of collaboration between the government and industry stakeholders to develop the standards for ethical and responsible use of AI and Blockchain in healthcare within smart cities.
5. To propose recommendations for designing regulatory frameworks that promote innovation and growth in healthcare and Smart Cities through the application of AI and Blockchain technologies, while ensuring the protection of public interest and maintaining ethical, secure, and responsible use of these technologies.

Significance of Study

India is currently one of the fastest-growing economies in the world, and the use of AI and blockchain technology is becoming increasingly prevalent in various sectors, including healthcare in smart cities. The potential benefits of these technologies in these sectors include improved efficiency, cost savings, and better healthcare outcomes. However, there are also significant challenges and risks associated with the use of these technologies, such as concerns around data privacy, security, and bias.

To address these challenges, regulatory frameworks are needed to ensure that these technologies are developed and deployed in a responsible and ethical manner. In India, the government has taken some steps towards developing such frameworks, such as the National AI Strategy and the National Digital Health Mission. However, there is still a need for further regulatory analysis and policy development to address the complex legal, ethical, and societal issues raised by these technologies.[7]

In comparison, both the EU and the US have more established regulatory frameworks for AI and blockchain technology. For example, the EU has developed the General Data Protection Regulation (GDPR) to address data privacy concerns, while the US has established the National Institute of Standards and Technology (NIST) to provide guidance on cybersecurity and privacy for AI and blockchain technology.[8] By comparing the regulatory frameworks in these regions, it is possible to identify best practices and to develop a regulatory framework that is tailored to the specific needs of India.

Therefore, the study of regulatory analysis of AI and blockchain technology in healthcare and smart cities is essential for ensuring the responsible and ethical development and deployment of these technologies in India, as well as in other countries around the world. While India has made some progress towards developing regulatory frameworks for these technologies, there is still a need for further analysis and policy development to address the complex challenges and risks associated with their use. Further, the comparative analysis with the EU and the US, is significant because it provides insights into how these technologies can be developed and deployed in a responsible and ethical manner, while also meeting the needs of society.

Therefore, the significance of this research can be summarized in the following points:

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[7] Nayak, N. (2021). The Ethics of Artificial Intelligence and Machine Learning: A Pragmatic Approach. In P. Mohapatra, S. Biswas, S. Saha, & S. Mukhopadhyay (Eds.), Handbook of Research on Ethics, Entrepreneurship, and Governance in Higher Education (pp. 163-183). IGI Global. https://doi.org/10.4018/978-1-7998-7958-8.ch009

[8] European Commission. (2016). General Data Protection Regulation (GDPR). https://ec.europa.eu/info/law/law-topic/data-protection_en

Firstly, this research will provide a comprehensive understanding of the current regulatory landscape governing AI and Blockchain applications in healthcare within Smart Cities in India, the United States, and the European Union. This knowledge is vital for stakeholders in understanding the impact of regulations on the adoption and implementation of these technologies in healthcare. A thorough understanding of the regulatory frameworks will enable policymakers, industry stakeholders, and researchers to identify the strengths and weaknesses of existing regulations and to address them effectively.

Secondly, by examining the key technological challenges and regulatory gaps in implementing AI and Blockchain technologies in healthcare within Smart Cities, this research will help stakeholders identify areas that require attention, improvement, and further development. Identifying these challenges and gaps will facilitate targeted efforts in enhancing the effectiveness and efficiency of AI and Blockchain applications in healthcare, resulting in better healthcare outcomes for citizens in Smart Cities.

Thirdly, the comparative analysis of regulatory frameworks across India, the United States, and the European Union will help stakeholders identify best practices and potential solutions for addressing the challenges associated with the regulation of AI and Blockchain in healthcare within Smart Cities. By learning from the successes and shortcomings of different regulatory models, stakeholders can adapt and refine their own approaches, paving the way for more effective regulation and improved healthcare outcomes.

Fourthly, the research will provide insights into the role of regulatory analysis in fostering collaboration and standard-setting among government and industry stakeholders. This understanding is crucial for promoting public-private partnerships, international cooperation, and the development of unified standards to ensure the ethical and responsible use of AI and Blockchain technologies in healthcare. Effective collaboration and standard-setting will not only enhance the quality of healthcare delivery but also ensure that technological advancements remain aligned with societal values and ethical principles.

Fifthly, the research will explore strategies for balancing the promotion of innovation, growth, and public interest in the context of AI and Blockchain technologies in healthcare within Smart Cities. This will help policymakers and industry stakeholders develop policies and practices that strike an appropriate balance between fostering technological advancements, ensuring public health and safety, and addressing ethical and societal concerns. By identifying ways to maintain this balance, this research will contribute to the development of a sustainable and equitable healthcare ecosystem that leverages the benefits of AI and Blockchain technologies while mitigating potential risks.

The insights gained from this research will inform future policy and regulation, shaping the development and implementation of effective, ethical, and sustainable regulatory frameworks for AI and Blockchain technologies in healthcare. This will not only contribute to the academic literature on this subject but also have practical implications for policymakers, industry stakeholders, and researchers, ultimately enhancing the quality of healthcare delivery in Smart Cities.

Conceptual Framework

Regulatory analysis of AI and Blockchain involves examining the legal and regulatory frameworks that govern the use of these technologies in various contexts, such as healthcare in smart cities. In the case of India, the regulatory landscape for AI and Blockchain is still evolving, with several initiatives underway to develop frameworks for their safe and responsible use. This research proposes the following conceptual framework that can be used to analyze the regulatory environment for AI and Blockchain in healthcare in smart cities:

Background and Context

a. Artificial Intelligence (AI) and Blockchain technologies
b. Applications of AI and Blockchain in healthcare within Smart Cities
c. Regulatory landscape in India, the United States, and the European Union

Key Concepts and Variables

a. Technological challenges in implementing AI and Blockchain in healthcare
   - Integration with existing healthcare systems
   - Scalability and interoperability
   - Technical expertise and resources

b. Data privacy, security, and ethical use considerations
   - Protection of sensitive patient data
   - Ensuring secure data sharing and storage
   - Compliance with legal and ethical standards

c. Regulatory frameworks for AI and Blockchain technologies in healthcare within Smart Cities
   - Legal and regulatory requirements
   - Policy formulation and enforcement
   - Compliance monitoring and evaluation

d. Collaboration between government and industry stakeholders
   - Public-private partnerships
   - Industry associations and standard-setting bodies
   - Multilateral cooperation and international agreements

e. Best practices and potential solutions from comparative analysis
   - Regulatory models from India, the United States, and the European Union

- Lessons learned from successful implementations
- Recommendations for improving the regulatory landscape

f. Balance between innovation, growth, and public interest
   - Promoting technological advancements and economic growth
   - Ensuring public health and safety
   - Addressing ethical and societal concerns

Relationships and Interactions

a. The impact of AI and Blockchain technologies on healthcare delivery and outcomes within Smart Cities
b. The role of regulatory frameworks in addressing technological challenges, data privacy, security, and ethical use concerns
c. The influence of regulatory analysis on fostering collaboration and standard-setting
d. The relationship between regulatory frameworks and the promotion of innovation, growth, and public interest

Research Questions and Objectives

a. Identify key technological challenges and regulatory gaps in implementing AI and Blockchain technologies in healthcare within Smart Cities
b. Examine the existing regulatory frameworks in India, the United States, and the European Union
c. Conduct a comparative analysis to identify best practices and potential solutions
d. Investigate the role of regulatory analysis in fostering collaboration and standard-setting
e. Explore strategies for balancing innovation, growth, and public interest in the context of AI and Blockchain technologies in healthcare within Smart Cities

Expected Outcomes

a. Insights into the key technological challenges and regulatory gaps
b. A comprehensive understanding of the regulatory landscape in India, the United States, and the European Union
c. Recommendations for the development and implementation of effective, ethical, and sustainable regulatory frameworks

d. Strategies for fostering collaboration and standard-setting among stakeholders
e. A balanced approach to promoting innovation, growth, and public interest in AI and Blockchain technologies in healthcare within Smart Cities

By following this detailed conceptual framework, this thesis will provide a comprehensive understanding of the regulatory landscape for AI and Blockchain applications in healthcare within Smart Cities, specifically focusing on the Indian context and drawing comparisons with the United States and the European Union. The insights gained from this research will be valuable for informing policymakers, industry stakeholders, and researchers in the development and implementation of effective, ethical, and sustainable regulatory frameworks for AI and Blockchain technologies in healthcare.

Research Design

Research Methodology: The Research Methodology adopted in this research is empirical as well as non- empirical. The Primary data will be collected through case studies, surveys and interviews with experts, stakeholders, policymakers, and industry leaders.

Secondary data can be collected from government reports, industry publications, existing laws and regulations, and other relevant sources. Since the regulatory analysis of AI & blockchain in India is still in its nascent stage, with no specific legislation or regulatory framework. However, the government has constituted a task force on AI to examine the policy and regulatory framework needed for AI adoption, including healthcare in smart cities. The task force is also examining the impact of AI on the workforce, privacy, security, and ethical issues. In contrast, the US and EU have already established regulatory frameworks for AI and blockchain, including in the healthcare and smart cities domains. For instance, the US FDA has issued guidelines for the regulation of AI in medical devices, while the EU has proposed regulations for AI applications in critical domains such as healthcare and transportation.

During the non-empirical study, a comparative research design approach shall also be adopted which would include analysis of the regulatory frameworks in India, US, and EU. This would involve a critical examination of the legal and regulatory structures, policy approaches, and stakeholder perspectives. The research will also involve a review of relevant literature, reports, and case studies on AI and blockchain regulation in healthcare and smart cities.

Target Group: the target population includes a diverse group of stakeholders involved in the development, implementation, and regulation of AI and Blockchain technologies in healthcare within Smart Cities. These stakeholders can be categorized as follows:

- **Healthcare providers:** Healthcare professionals, hospitals, clinics, and other healthcare institutions involved in implementing AI and Blockchain technologies to improve healthcare delivery and patient outcomes in Smart Cities. Also investigating about data privacy, and ethical issues related to the use of AI and Blockchain technologies in healthcare within Smart Cities.
- **Technology developers and vendors**: Companies and organizations developing and providing AI and Blockchain solutions, products, and services for healthcare applications within Smart Cities.
- **Academics and researchers:** Experts from universities, research institutions, and think tanks who have expertise in AI, Blockchain, healthcare, and regulation, and who can

provide valuable insights on the regulatory landscape, technological challenges, and potential solutions.

Sample size and technique: The sample size will be determined based on the feasibility and availability of participants. For Empirical Research, the thesis aims to conduct interviews and surveys with the relevant target group.

For conducting **interviews, a purposive sampling technique** to select the most relevant and knowledgeable participants from each stakeholder group will be adopted. A reasonable sample size for interviews could be around 10-15 participants per stakeholder group, resulting in a total of 30-45 interviewees across all groups.

For conducting **surveys** larger sample sizes would be required to ensure the validity and generalizability of the findings. This research will use **stratified random sampling or convenience sampling** to select participants from each stakeholder group. Considering the diversity of the target population and the need for a comparative analysis, a sample size of 200-300 participants might be appropriate.

Data Collection: The primary data will be collected through surveys and interviews. Surveys will be conducted with the participants to collect their opinions and perceptions about the regulatory frameworks of AI and Blockchain in healthcare in smart city. Interviews and surveys will be conducted with relevant target group to collect their insights and experiences regarding the regulatory frameworks. The secondary data will be collected from various sources, such as government reports, academic publications, and industry reports.

Data Analysis: The data collected from the surveys, and interviews will be analyzed using qualitative and quantitative research methods. The qualitative data will be analyzed using content analysis to identify the themes and patterns in the data. The quantitative data will be analyzed using statistical analysis to identify the differences and similarities in the regulatory frameworks of AI and Blockchain in the healthcare and smart city domains in India, the United States, and the European Union.

Expected Outcome: This research in the end aims to provide valuable insights into the policy and regulatory challenges and opportunities for these emerging technologies. It will also help to identify best practices and recommendations for the development of effective regulatory frameworks that promote innovation while safeguarding public health, safety, and privacy.

Chapterisation

Chapter 1: Introduction

- Background and context of the study
- Literature Review
- Problem statement and research questions
- Significance and scope of the study
- Objectives and methodology

Chapter 2: Conceptual and Theoretical Perspectives

- Overview of Artificial Intelligence and Blockchain technologies
- Applications of AI and Blockchain in healthcare within Smart Cities
- Existing regulatory frameworks in India, the United States, and the European Union
- Key technological challenges in implementing AI and Blockchain technologies in healthcare.
- Data privacy, security, and ethical use considerations
- Role of regulatory analysis in fostering collaboration and standard-setting
- Balance between innovation, growth, and public interest

Chapter 3: Qualitative Findings

- Key technological challenges in implementing AI and Blockchain technologies in healthcare within Smart Cities
- Insights from stakeholder interviews

Chapter 4: Quantitative Findings

- Descriptive and inferential statistical analysis of survey data
- Analysis of stakeholder opinions and experiences
- Relationships among variables under study
- Comparative Analysis and Best Practices

Chapter 5: Comparative analysis of regulatory frameworks in India, the United States, and the European Union

- Identification of best practices and potential solutions
- Recommendations for the development and implementation of effective, ethical, and sustainable regulatory frameworks

Chapter 6: Findings, Conclusion, Recommendations and Suggestions

- Integration of qualitative and quantitative findings
- Addressing research questions, objectives, and hypotheses
- Implications for policymakers, industry stakeholders, and researchers
- Suggestions for the development of regulatory frameworks for AI and Blockchain technologies in healthcare within Smart Cities
- Limitations of the study and future research directions

Proposed Plan of Work

S.No.	Proposed Work	Tentative Date
1.	Thesis Proposal Defense	March 2023
2.	Extended Literature Review	April, 2023
3.	Stakeholders and collect Empirical Data	Last week of April, 2023
4.	Chapter 1 & 2	May, 2023
5.	Chapter 3 & 4	August, 2023
6.	Chapter 5 &6	November, 2023
7.	Publications	November, 2023
8.	Thesis Submission	January, 2024

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Legislations:

India

- The Digital Personal Data Protection Bill, 2022
- National Digital Health Mission (NDHM) guidelines
- The National Health Stack
- The Smart Cities Mission
- National Blockchain Strategy (draft policy)
- National Digital Health Blueprint, 2019
- National Strategy for Artificial Intelligence, 2018 (policy document)
- National Health Policy, 2017
- National E-Governance Plan, 2006
- Information Technology (IT) Act, 2000

USA

- Health Insurance Portability and Accountability Act (HIPAA), 1996
- 21st Century Cures Act, 2016
- Federal Trade Commission Act (FTC Act)
- Food and Drug Administration (FDA) guidance on AI/ML-based medical devices
- Health Information Technology for Economic and Clinical Health Act (HITECH), 2009
- National Artificial Intelligence Initiative Act of 2020
- State-level data protection and privacy laws (e.g., California Consumer Privacy Act)

European Union

- General Data Protection Regulation (GDPR), 2016
- Medical Device Regulation (MDR), 2017
- ePrivacy Regulation (proposed)
- EU Artificial Intelligence Act (proposed)
- EU Blockchain Resolution, 2018
- Digital Services Act (proposed), 2020
- Digital Markets Act (proposed), 2020